



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

**Applications of the Multilayer Level Set Method in
Interface and Inverse Problems**

By

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ABSTRACT

The multilayer level set method, previously developed by the author during MPhil research, extends the standard level set method by using a single level set function to represent multiple interfaces with subcell resolution. Preliminary results from the earlier MPhil thesis showed its effectiveness for motion of multiple interfaces and inverse source problems of the Schrödinger equation, but the original formulation was restricted to partially ordered subdomains. This thesis first introduces a disjoint configuration to remove this restriction and broaden the class of admissible interface geometries. The main contributions of this thesis are the extension of the multilayer level set method to new geometric problems and adaptive settings. We apply the method to inverse source problems of the Schrödinger equation, eikonal-based traveltime tomography and propose a multilayer level set approach to a generalized obstacle problem, where solutions and obstacles are represented by curves or surfaces rather than function graphs. To improve the resolution of neighboring interfaces while reducing the number of grid points, we further develop an adaptive grid strategy inspired by moving mesh methods. By using a unified partial differential equation that couples interface motion and grid motion, the proposed approach avoids interpolation between meshes. Numerical results demonstrate that the adaptive multilayer level set method is memory efficient and capable of resolving closely situated interfaces with high accuracy.

Date : 17 July 2026, Friday

Time : 10:00 am

Venue : Room 4502 (near Lifts 25/26)

Thesis Examination Committee:

Chairman : Prof. Simon Man Ho WONG, HUMA/HKUST

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(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).